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Climate Change and the Future of the American
West: Exploring the Legal and Policy
Dimensions (Summer Conference, June 7-9)

2006

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SLIDES: Energy

Randy Udall

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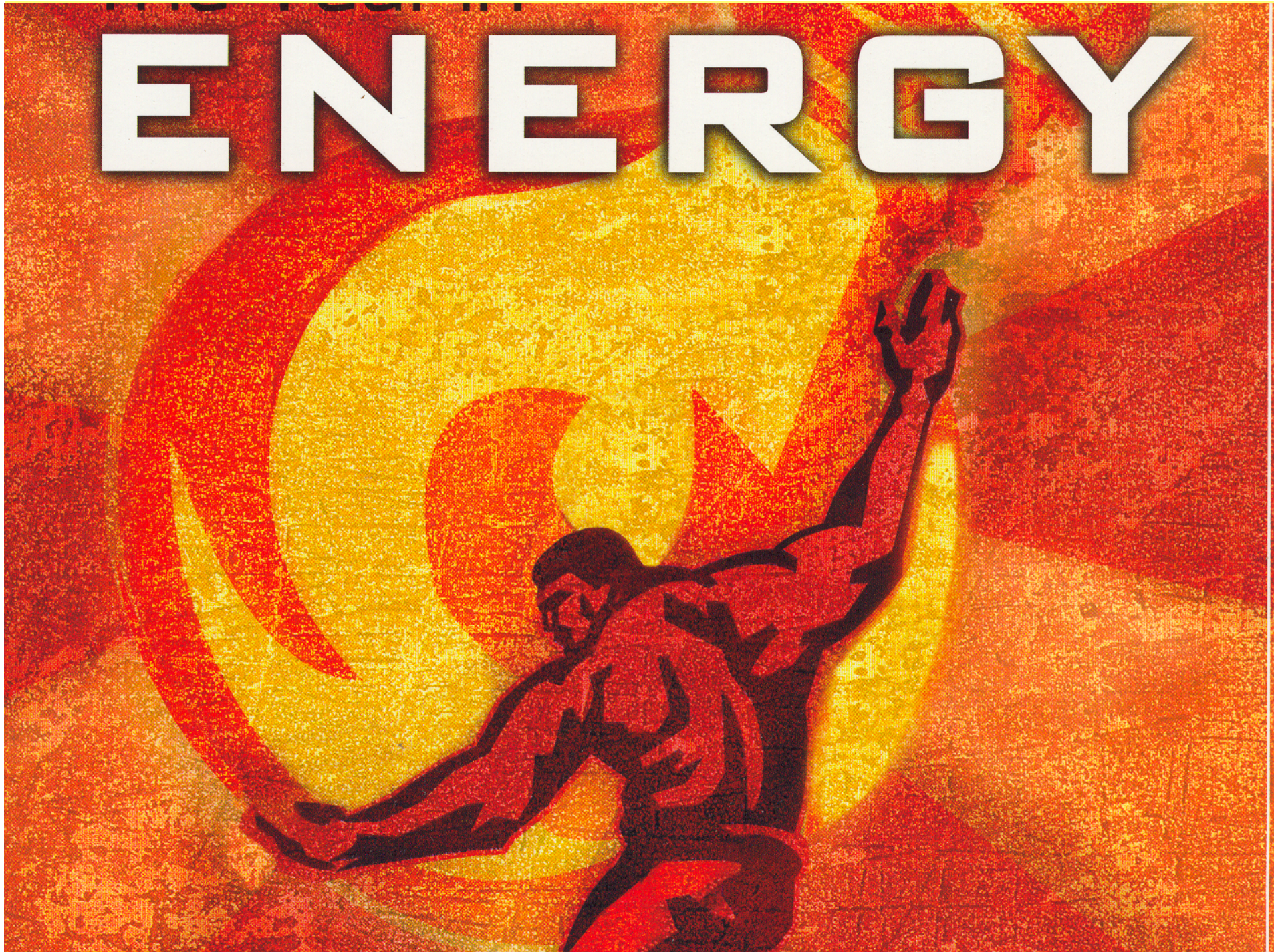


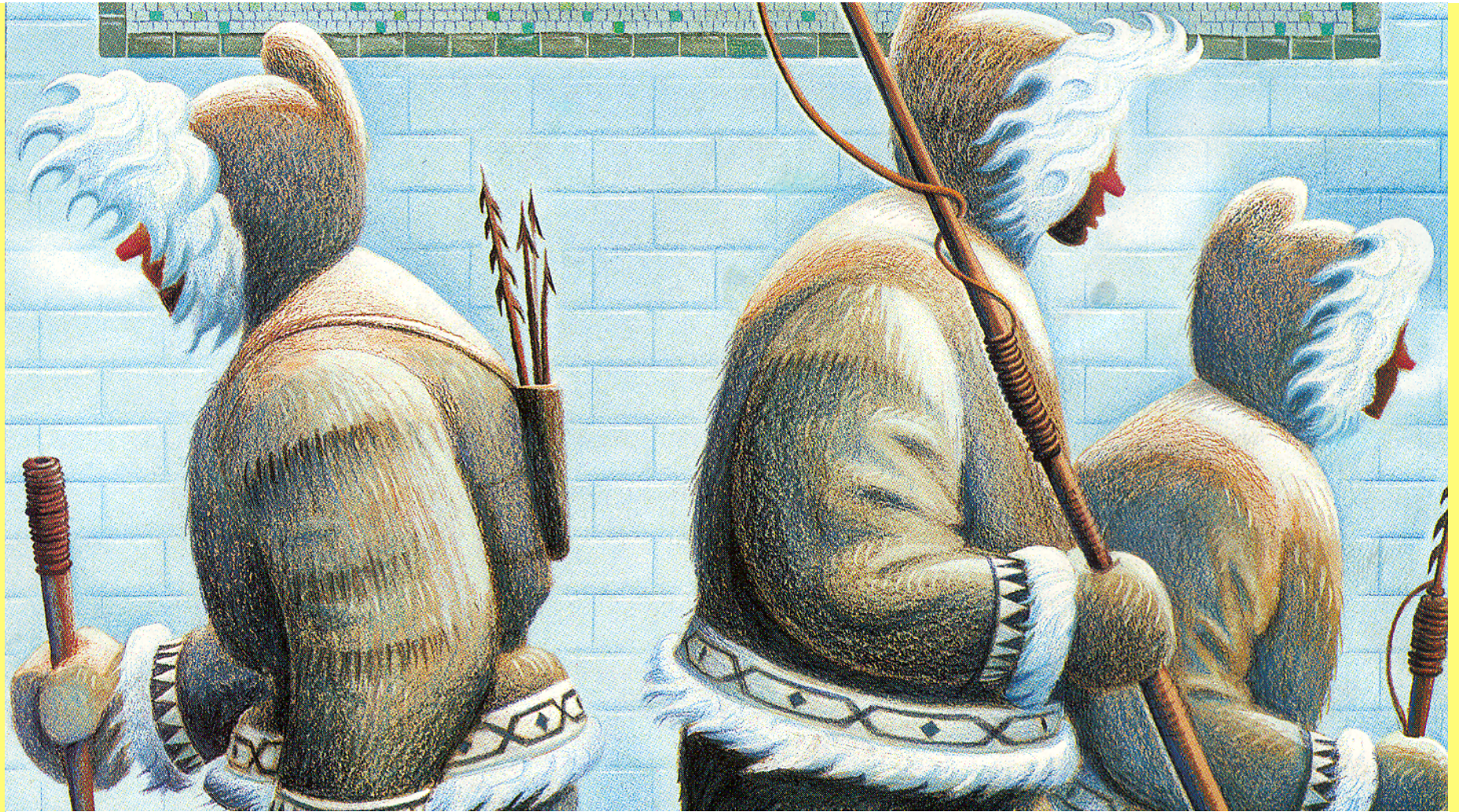
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Randy Udall, *Energy, in* CLIMATE CHANGE AND THE FUTURE OF THE AMERICAN WEST: EXPLORING THE LEGAL AND POLICY DIMENSIONS (Natural Res. Law Ctr., Univ. of Colo. Sch. of Law 2006).

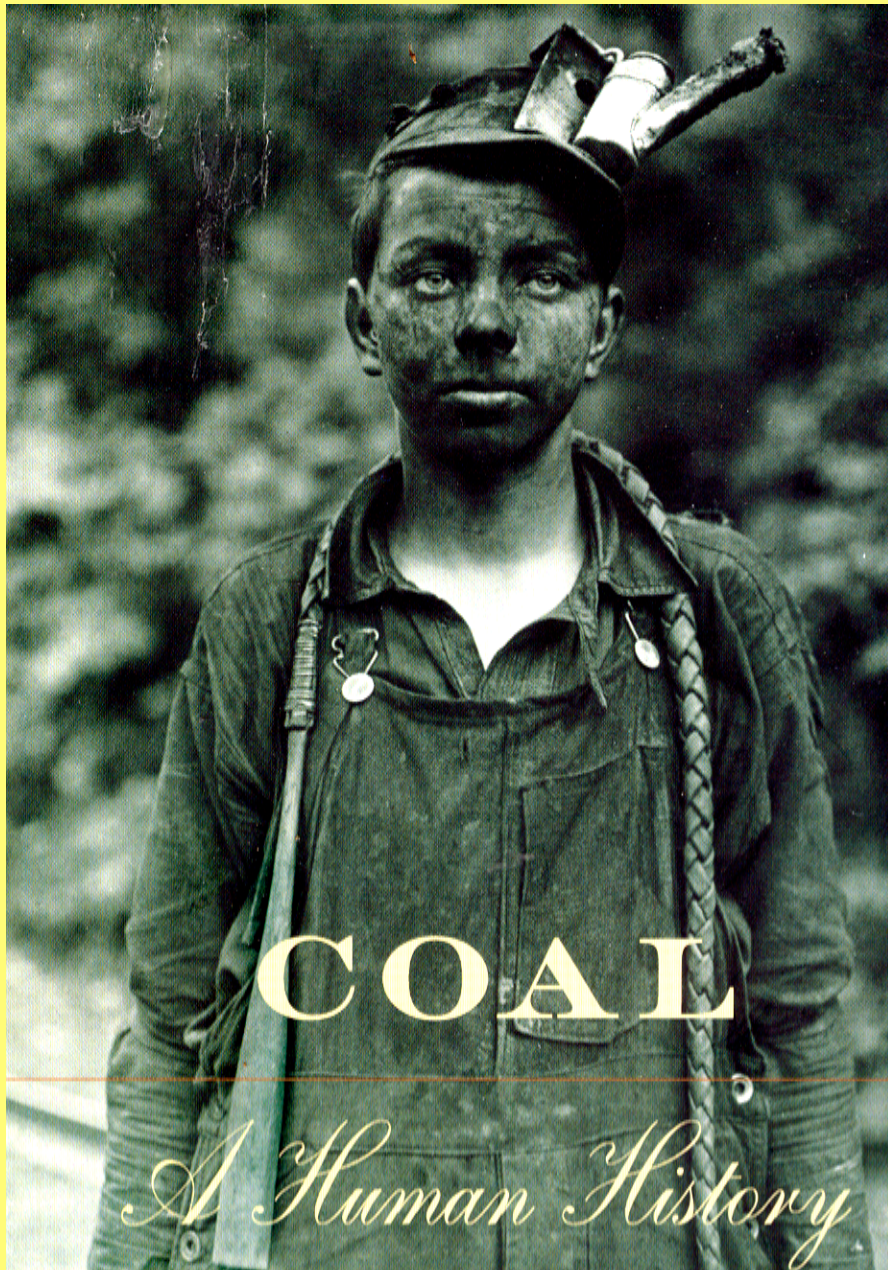
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ENERGY



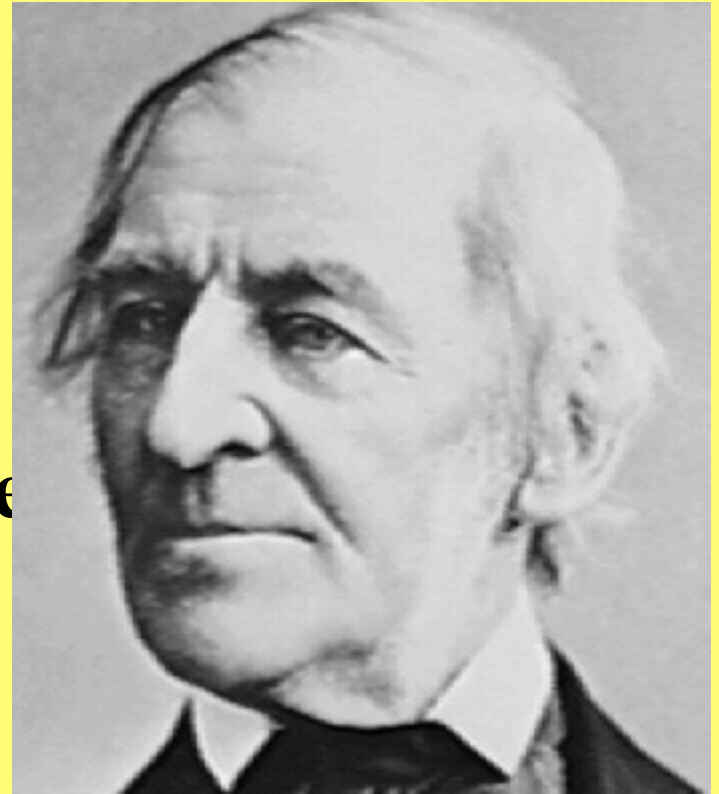


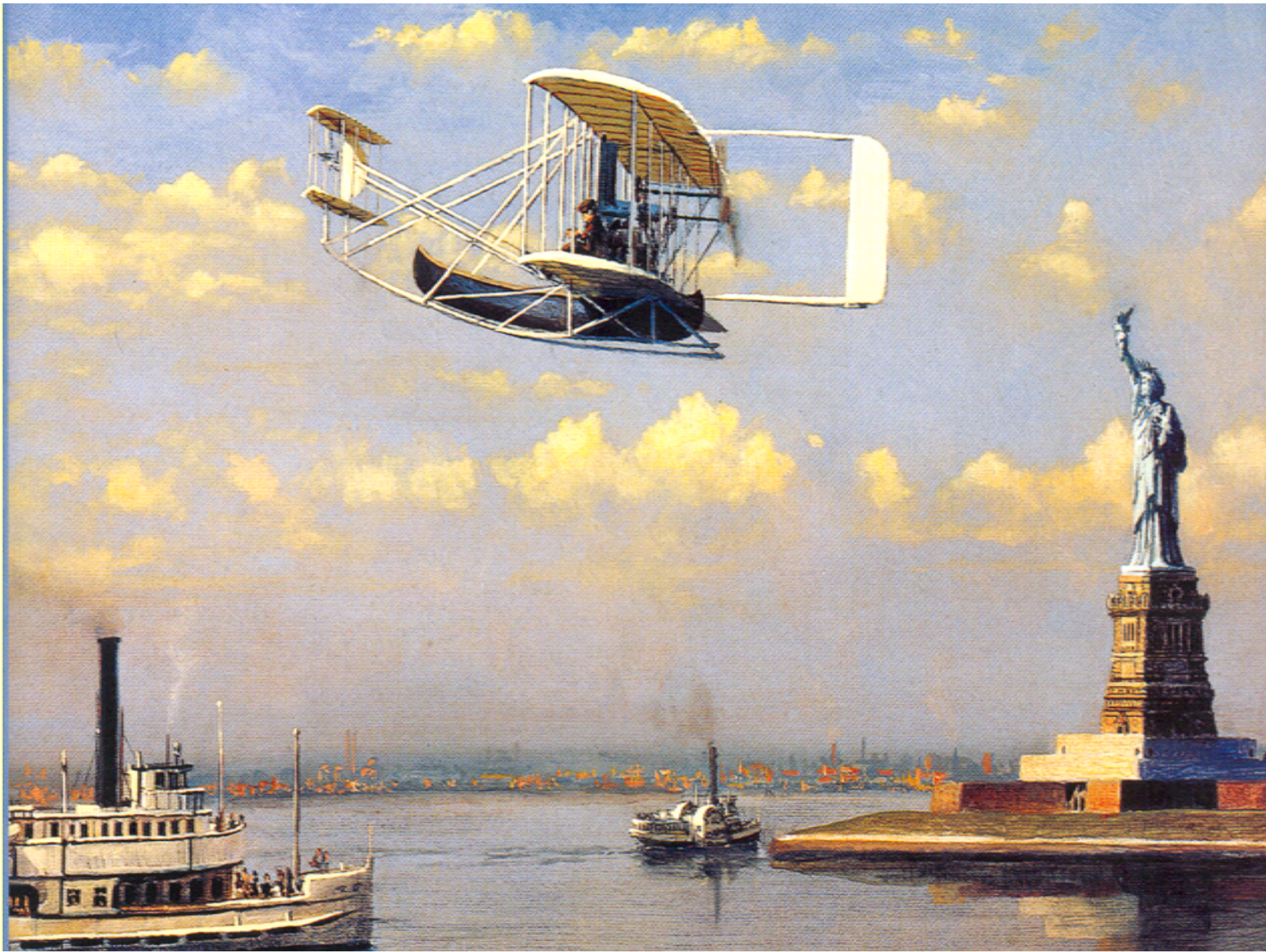
Man's long adventure with knowledge has been a climb up the heat ladder. The creature that crept furred through the glitter of blue glacial nights now lives surrounded by the hiss of steam and roar of engines...And he is himself a flame, a great roaring furnace...



“Coal Is A Portable Climate”

“James Watt whispered in the ear of mankind his secret, that a half-ounce of coal will draw two tons a mile, and coal carries coal, by rail and by boat, to make Canada as warm as Calcutta, and with its comfort brings industrial power.”



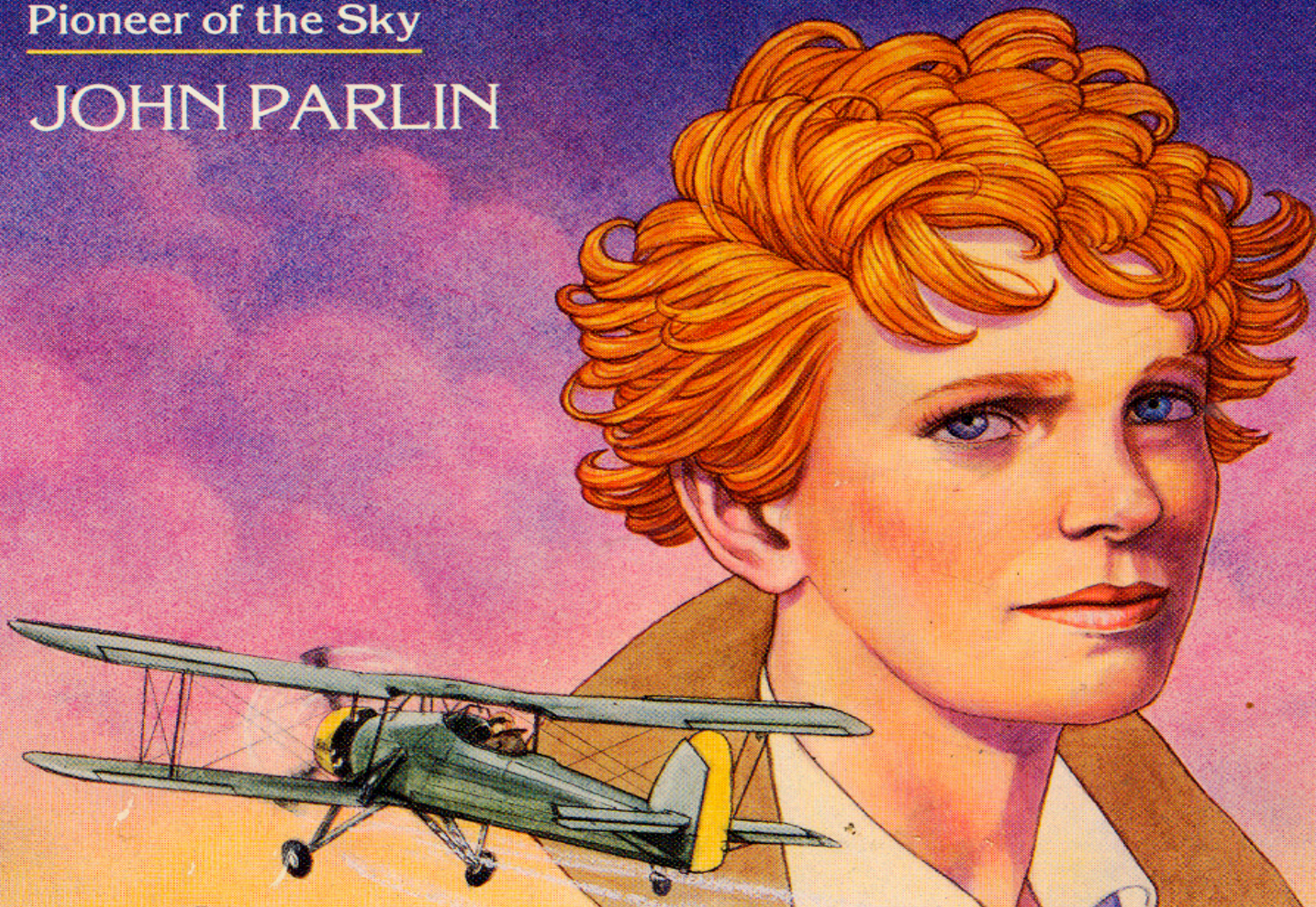


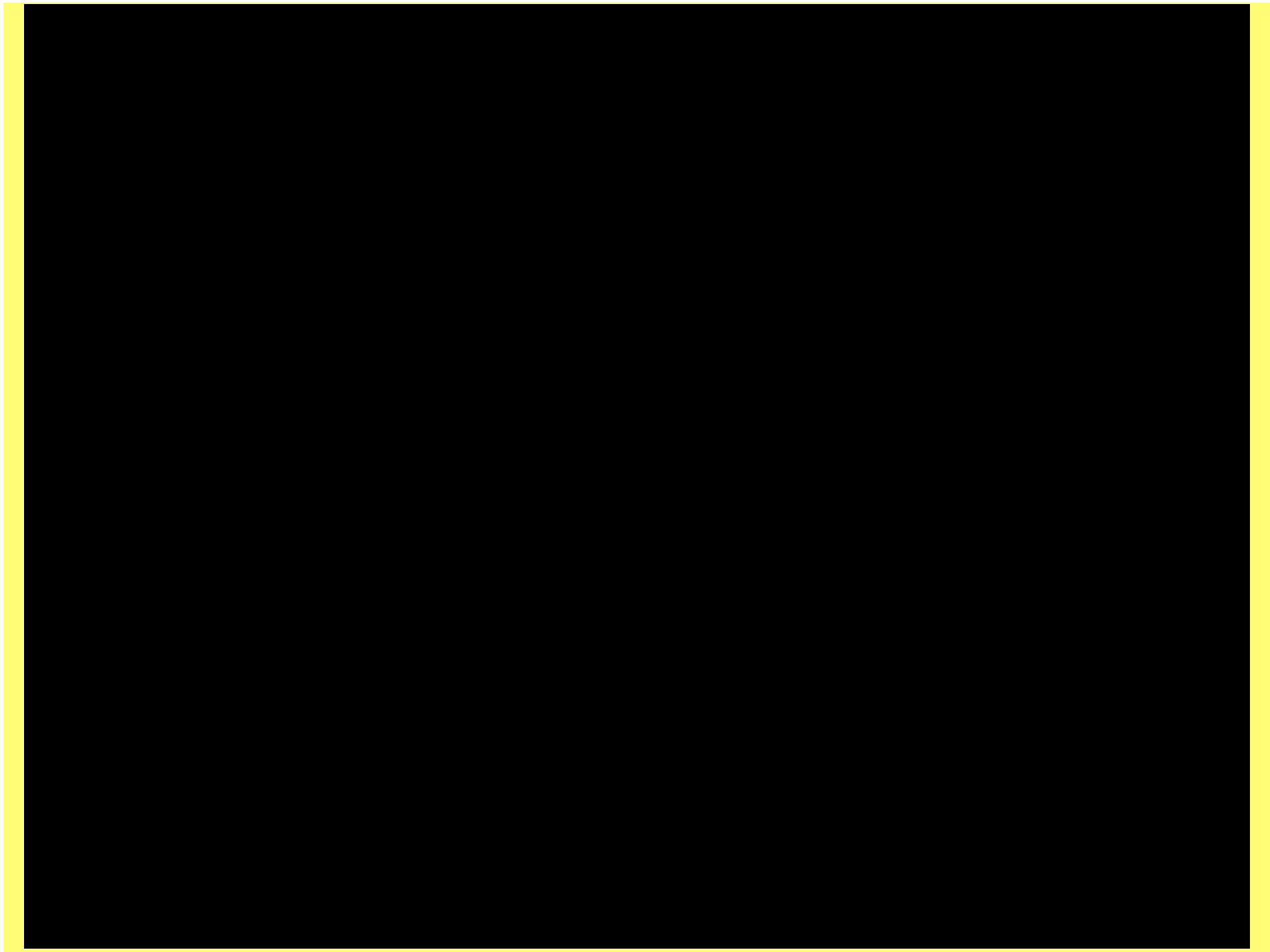


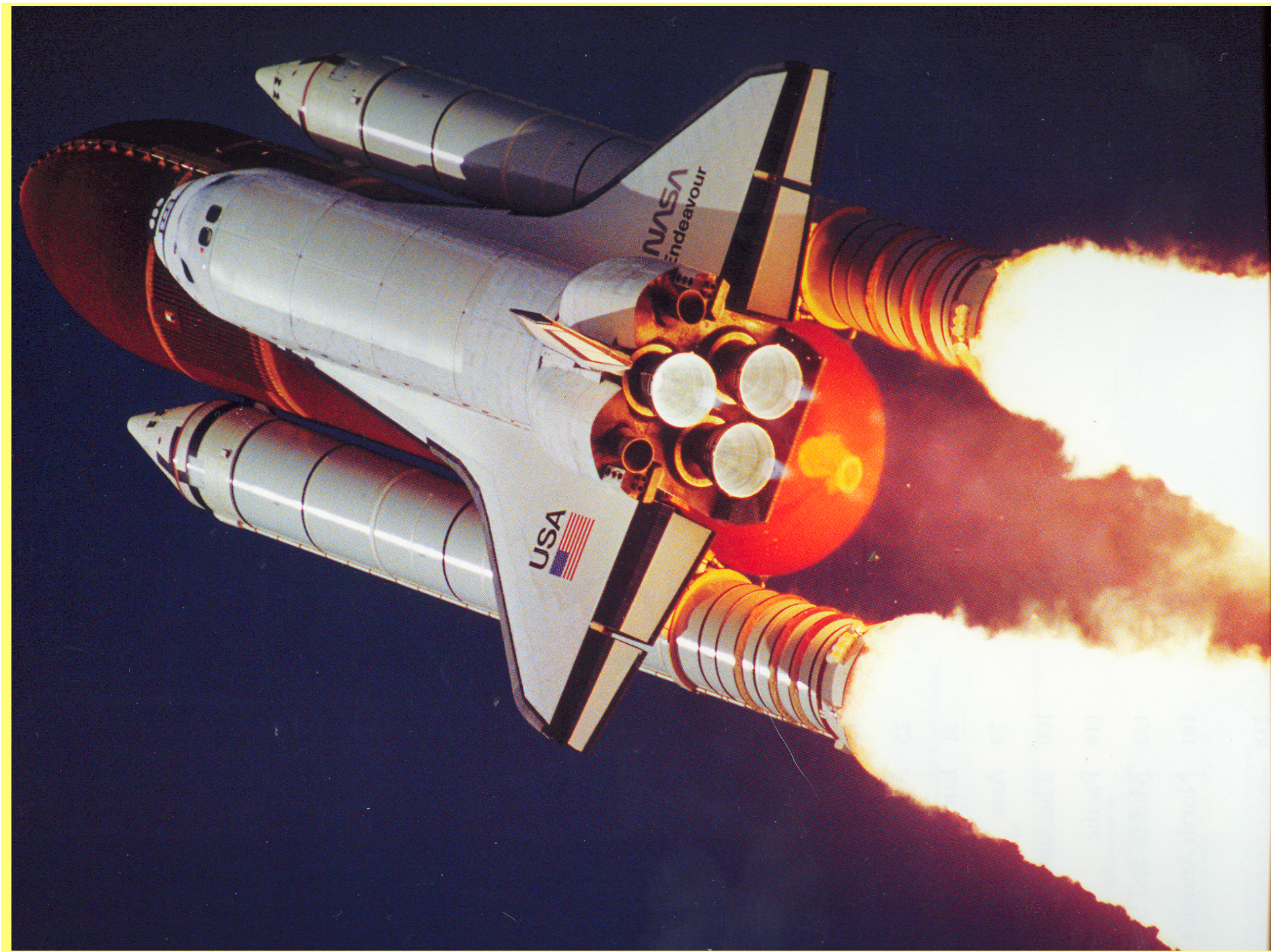
AMELIA EARHART

Pioneer of the Sky

JOHN PARLIN







Post Independent

Cutting carbon part of equation for Holy Cross

Customers want
utility to be green

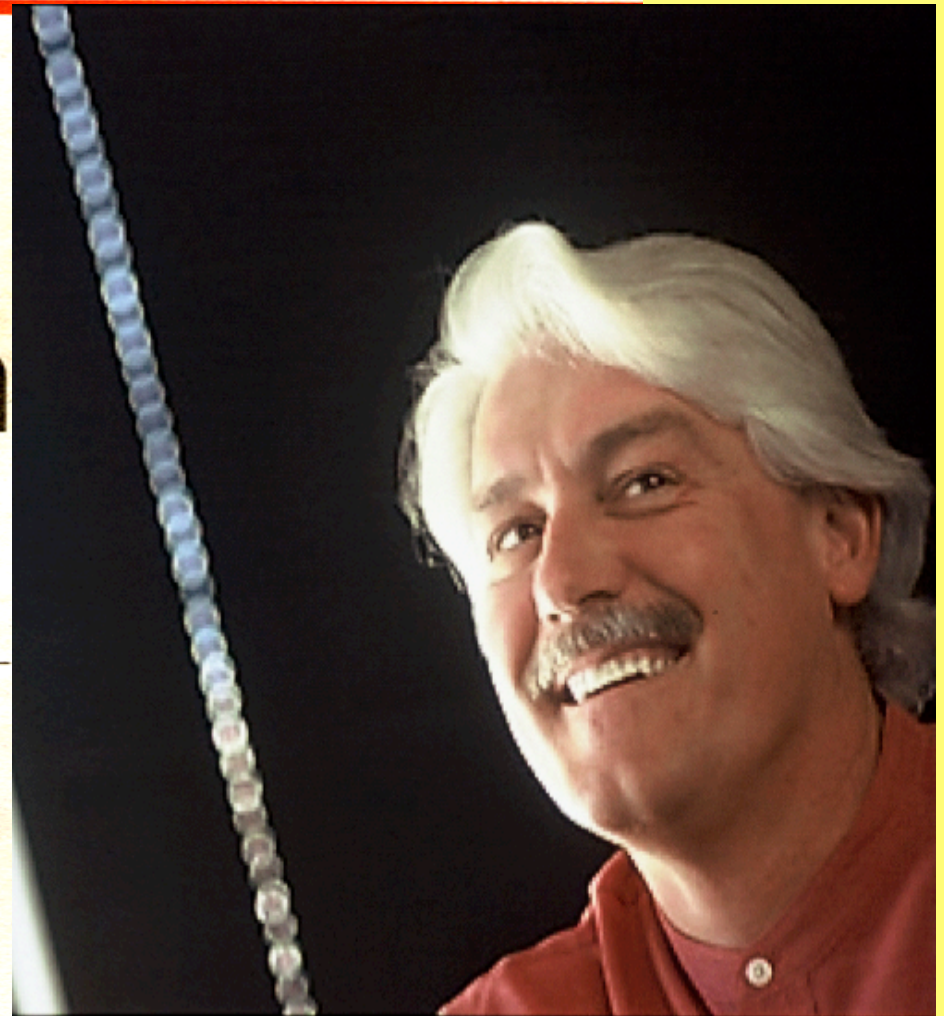
BY JEREMY HEIMAN

Special to the Post Independent

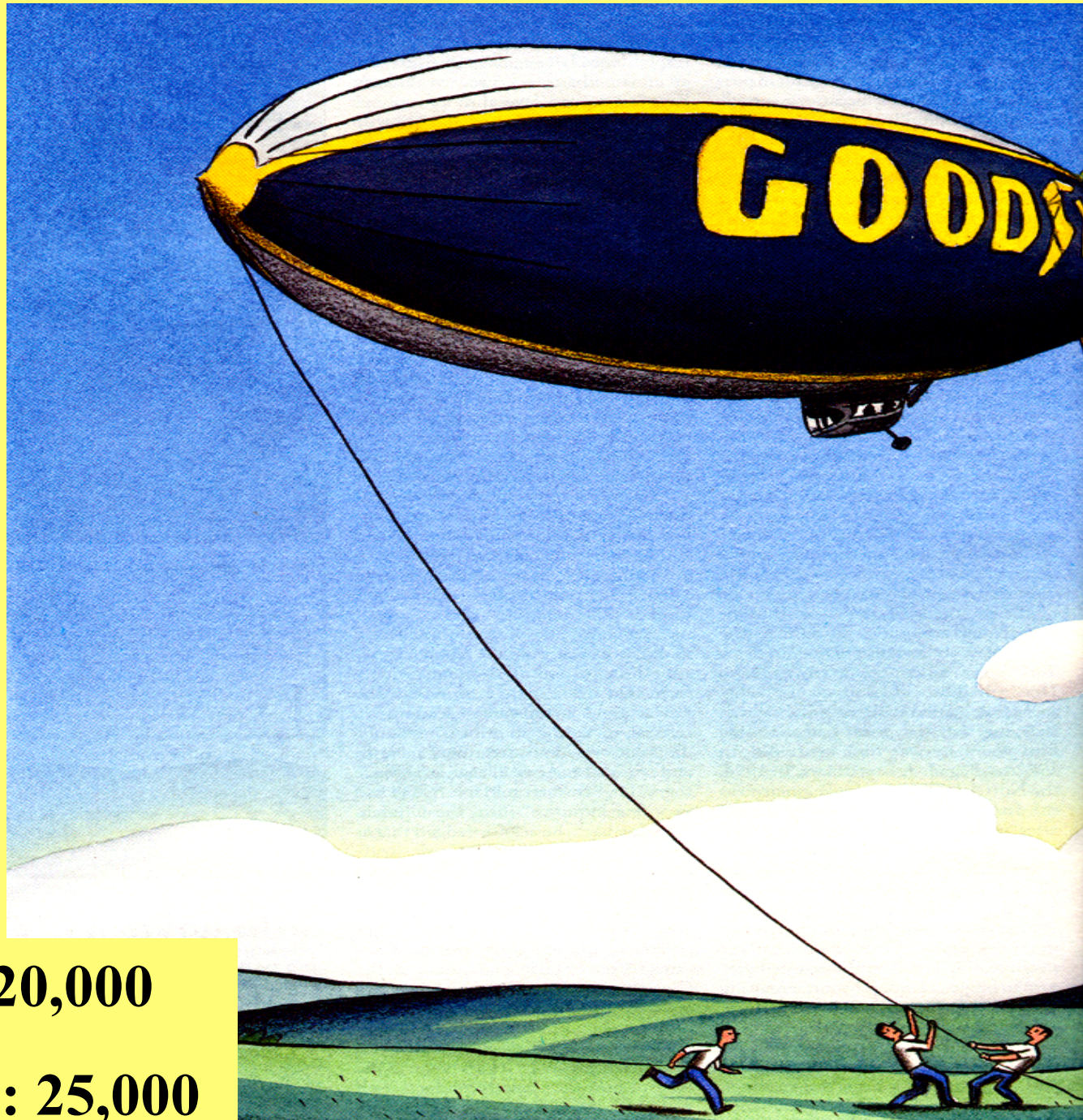
Holy Cross Energy isn't a
green giant among electric
utilities, but the company is

"Our customers
believe using fossil
fuels causes global
warming."

Bob Gardner
Holy Cross Energy







CARS: 20,000

HOUSE: 25,000



$\$10/\text{Month} = 8,000 \text{ lbs}$

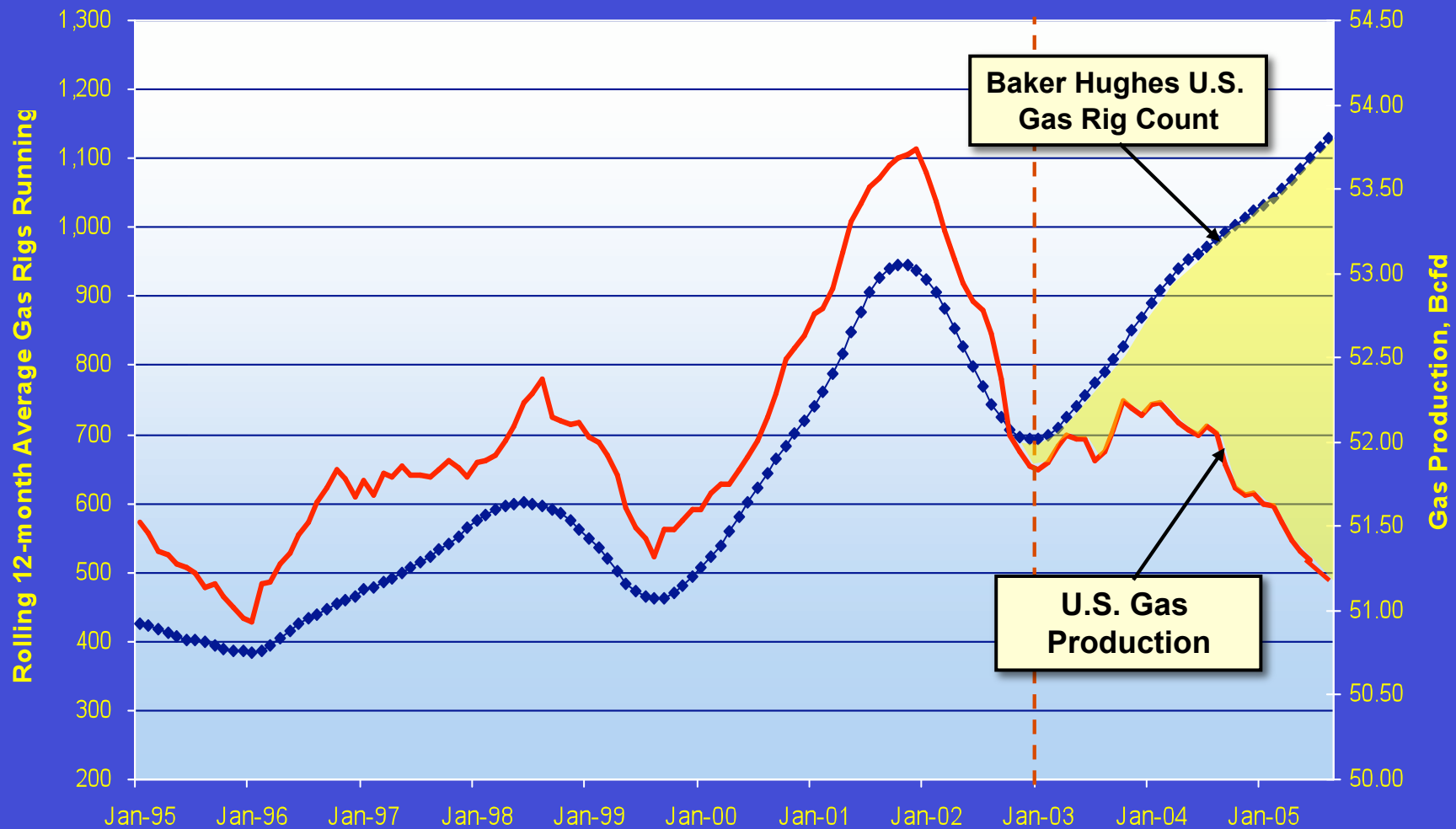


Wind Power Pioneers

- Buying 7 turbines (5 MW) wind
- Carbon intensity and RE targets
- Appliance efficiency rebates
- Hydro, Geothermal, Solar Rebates
- Invest in wind and coal mine methane
- Likely to purchase part of Comanche coal plant, interest in IGCC
- 1 million tons co2 avoided



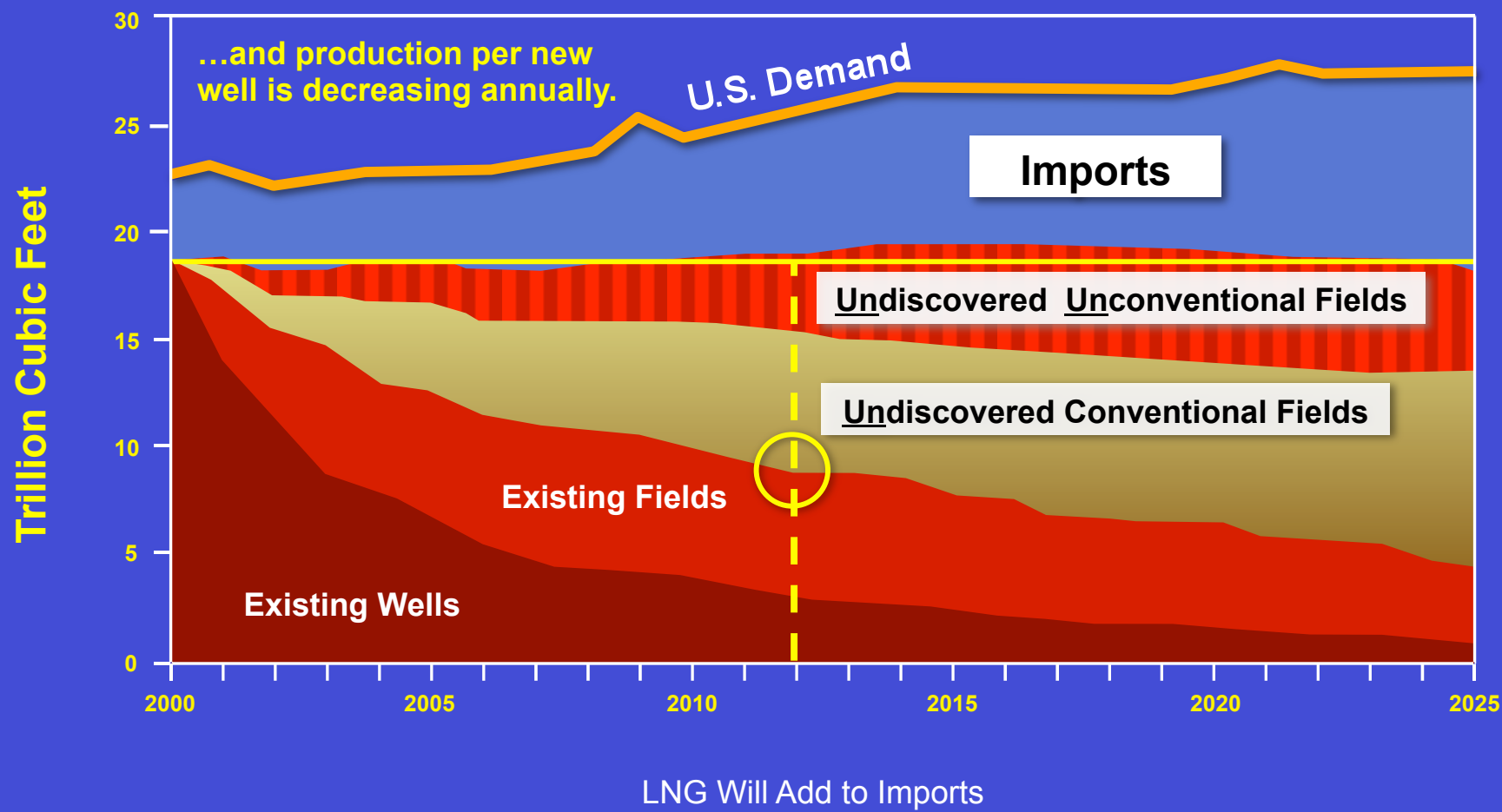
Gas Rig Count vs. Gas Production



*Based on Trailing 3 month average

Source: Baker Hughes, EIA/DOE (2004 and 2005 production volumes are EIA estimates)

Future U.S. Gas Supply



*Source: National Petroleum Council, 2004

Aspen Municipal

- Highest wind energy % in country
- New Hydro facility
- World's stiffest co2 tax has raised \$4M
- Canary Initiative





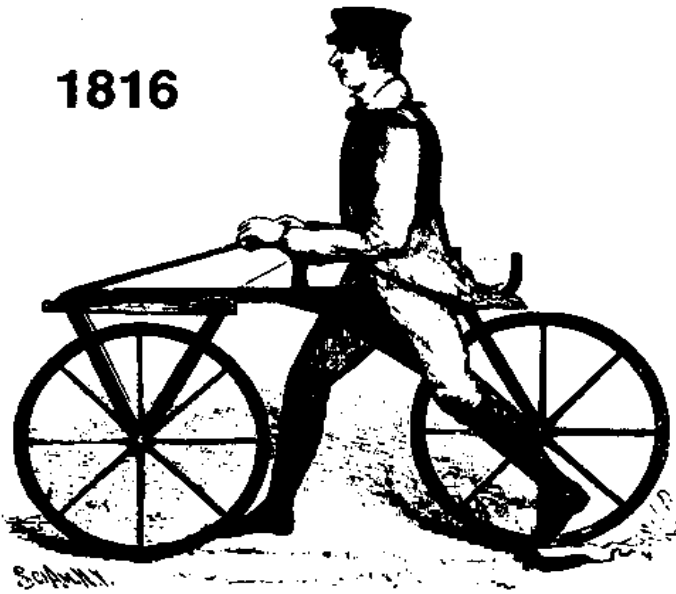
One MW of “Leftover Hydro”



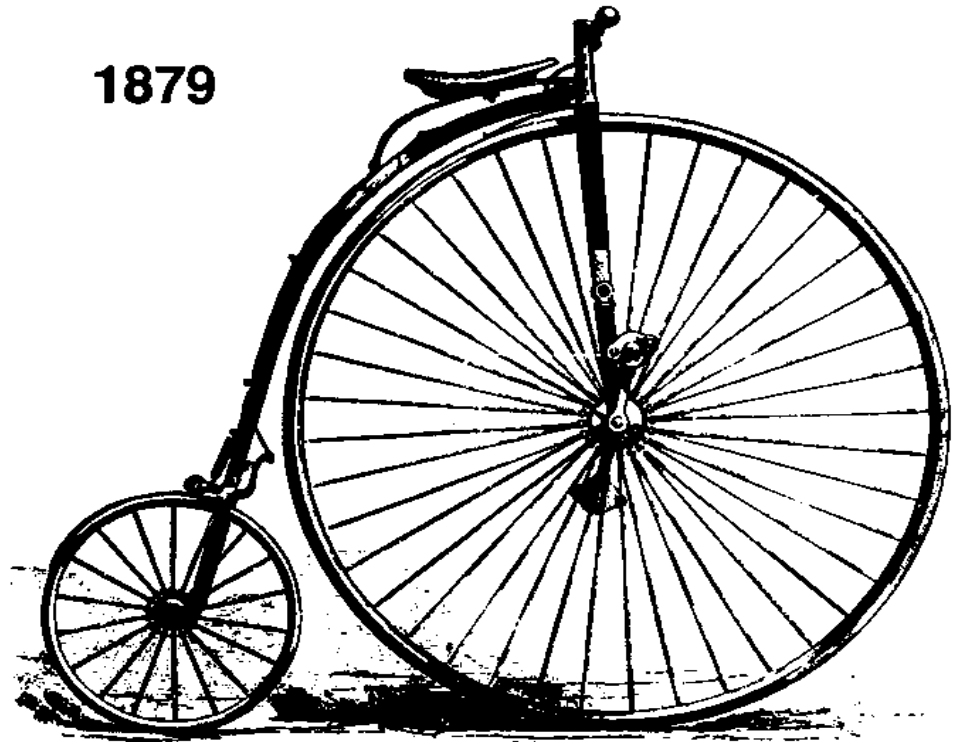




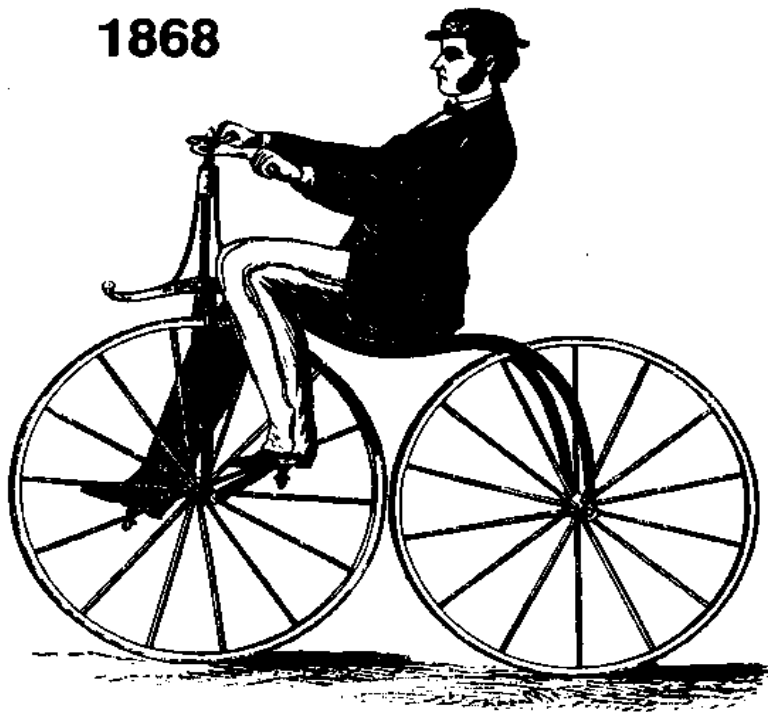
1816



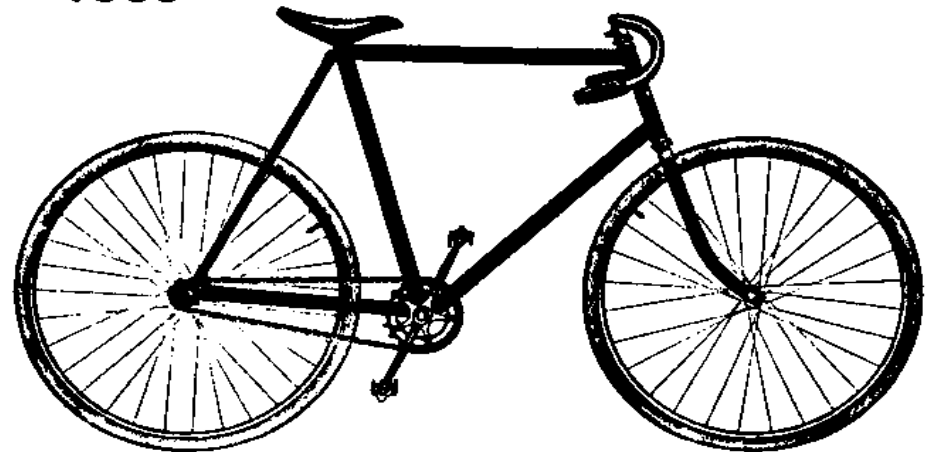
1879



1868



1889





The Final Energy Frontier

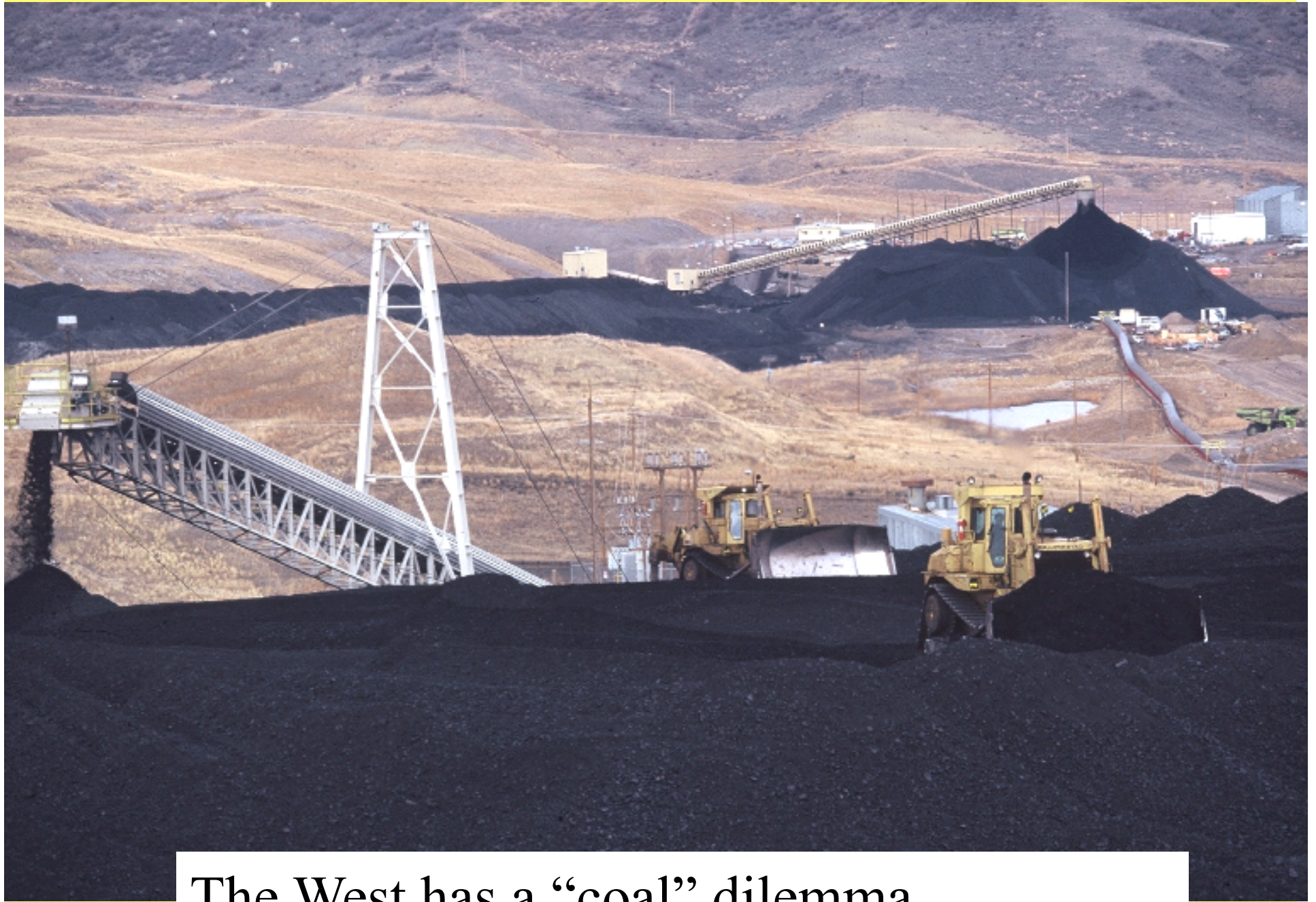
As the end of the oil and gas age nears, all eyes turn to the West.

Page 7.

BY

05

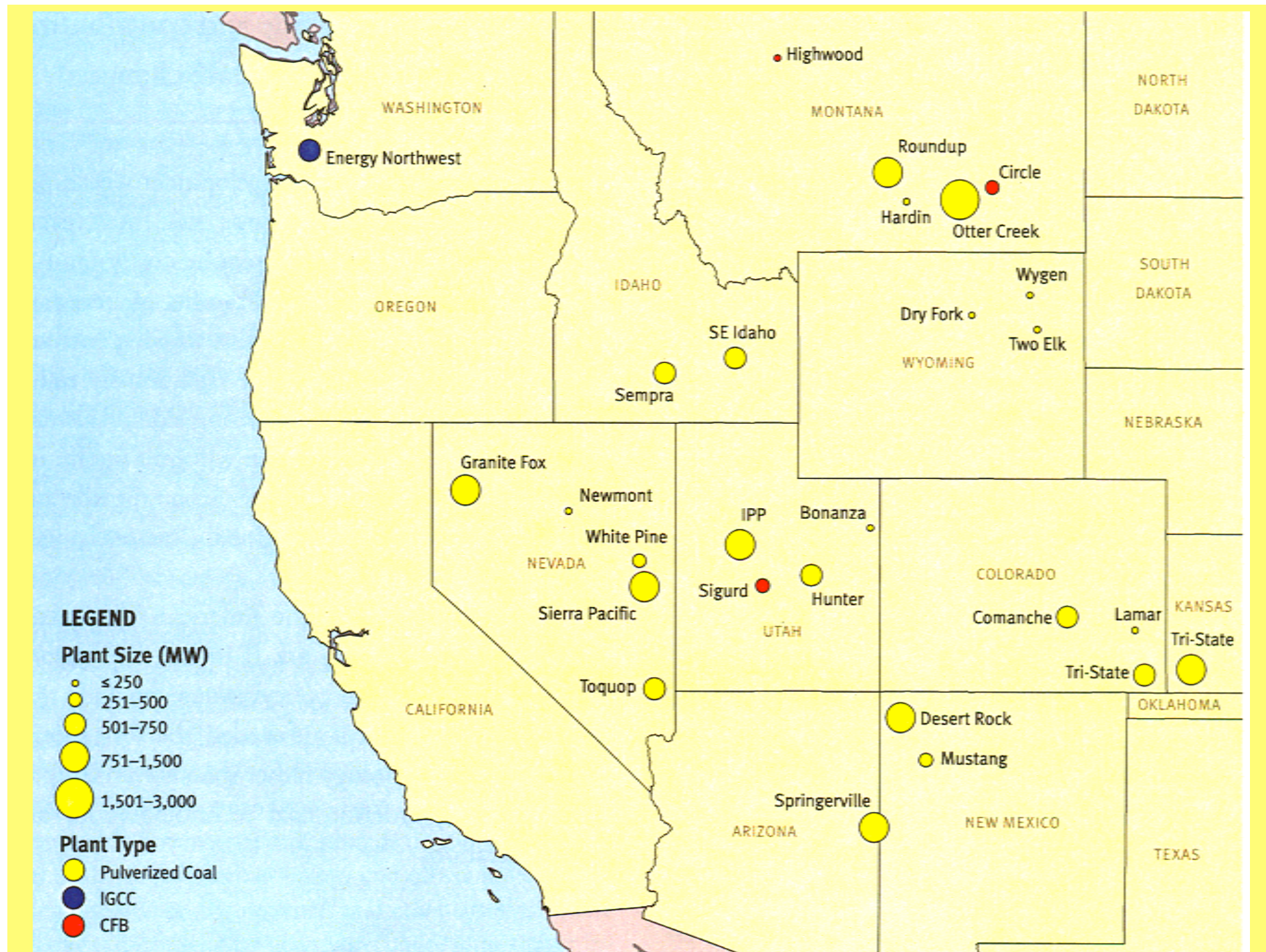




The West has a “coal” dilemma...



**“Wyoming boasts enough coal to weld every tie that binds,
drive every wheel, change the North Pole into a tropical
region or smelt all hell!” Fenimore Chatterton**



FUTURE FUELS FROM MONTANA

To make America less dependent on foreign oil, Montana Governor Brian Schweitzer pushes for investment in synfuel technology.

BY LEE BUCHSBAUM

"This country has no energy plan, no vision for the future," says the Democratic Governor of Montana, Brian Schweitzer. "We give more tax breaks and money for the oil industry, and what do we get? Three-dollar gas and wars in the Middle East. If you want to control the destiny of this country, it's going to be with synthetic fuels."

Since being elected in 2004, Governor Schweitzer has made transforming his state into a major energy producer one of his central political goals, and today he enjoys a 70% approval rating. Part of this is derived from his stance that Montana, which has more coal reserves than any other state, should become a leader in developing and harnessing the coal-to-liquids processes inherent in synfuel production, and that America's vast coal supply nationwide would be better utilized as an alternative to imported oil.

"At 120 billion tons, Montana's coal is, in liquid terms, enough to power the entire Middle East for decades, and to power every American car for decades,"



Gov. Schweitzer believes that Montana can become a

The United States imports about 13 million barrels of oil a day. To replace that oil would be a monumental undertaking, with hundreds of coal-to-fuel plants.

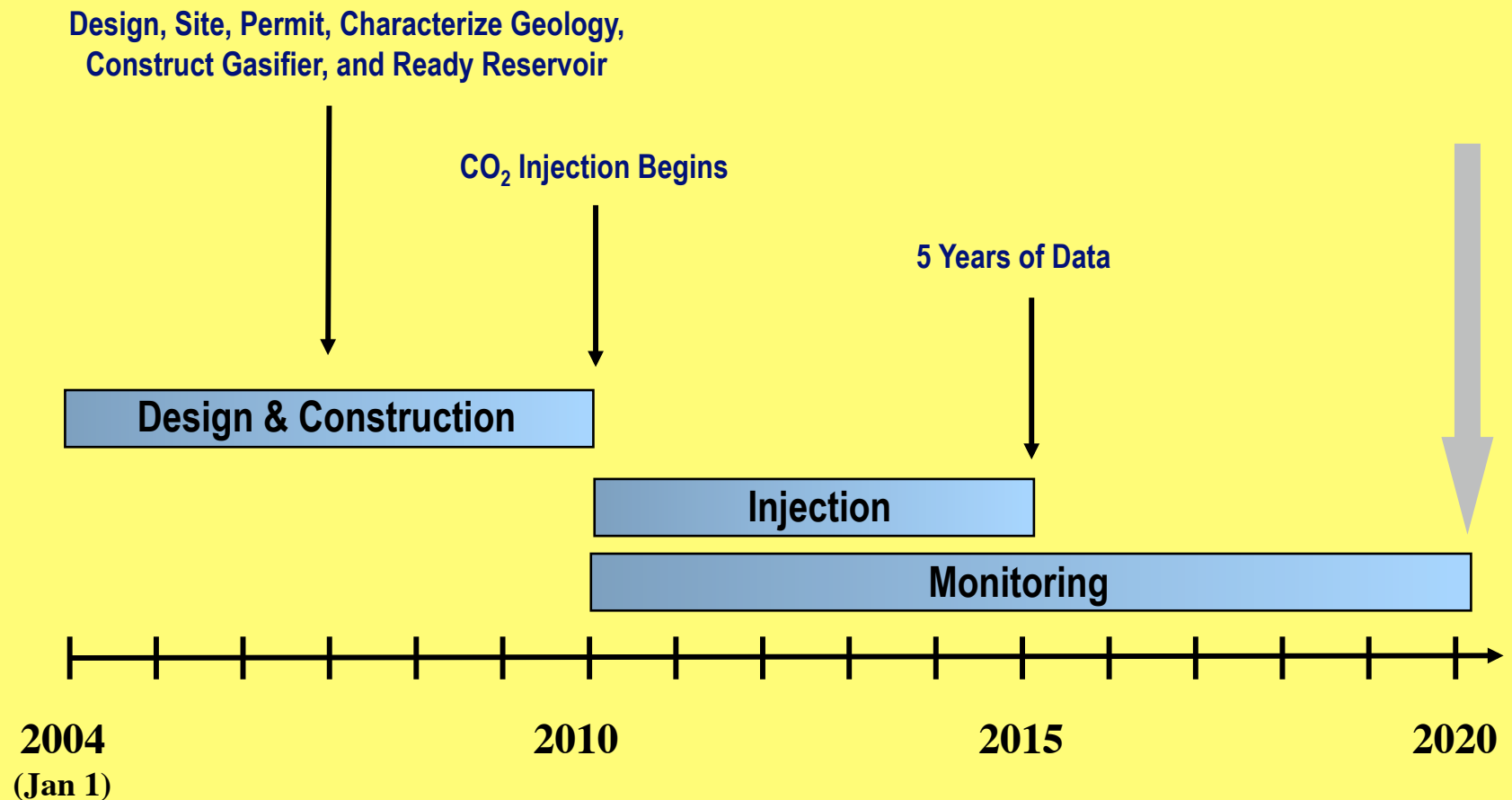
What's prevented a large scale coal-to-liquids development program from being implemented in the U.S. historically is cheap oil and the legislative power of the oil industry. "The U.S. government was seriously exploring synfuel as early as 1925," said Schweitzer. "In the 1940s, the Synthetic Liquid Fuels Act passed. Congress even appropriated over \$80 million for research and production. By the 1950s, America was producing thousands of gallons of synthetic gasoline a day at a test plant in Missouri. But with the discovery of cheap oil, combined with a lobby effort by the oil industry, the Federal government abandoned its synfuel research. During the oil crisis in the late 1970s, the federal government once again briefly discussed synfuel production, but abandoned it. The program has since receded."

...ing, the potential profits for those willing to invest in

50,000 B/D = \$10,000,000,000

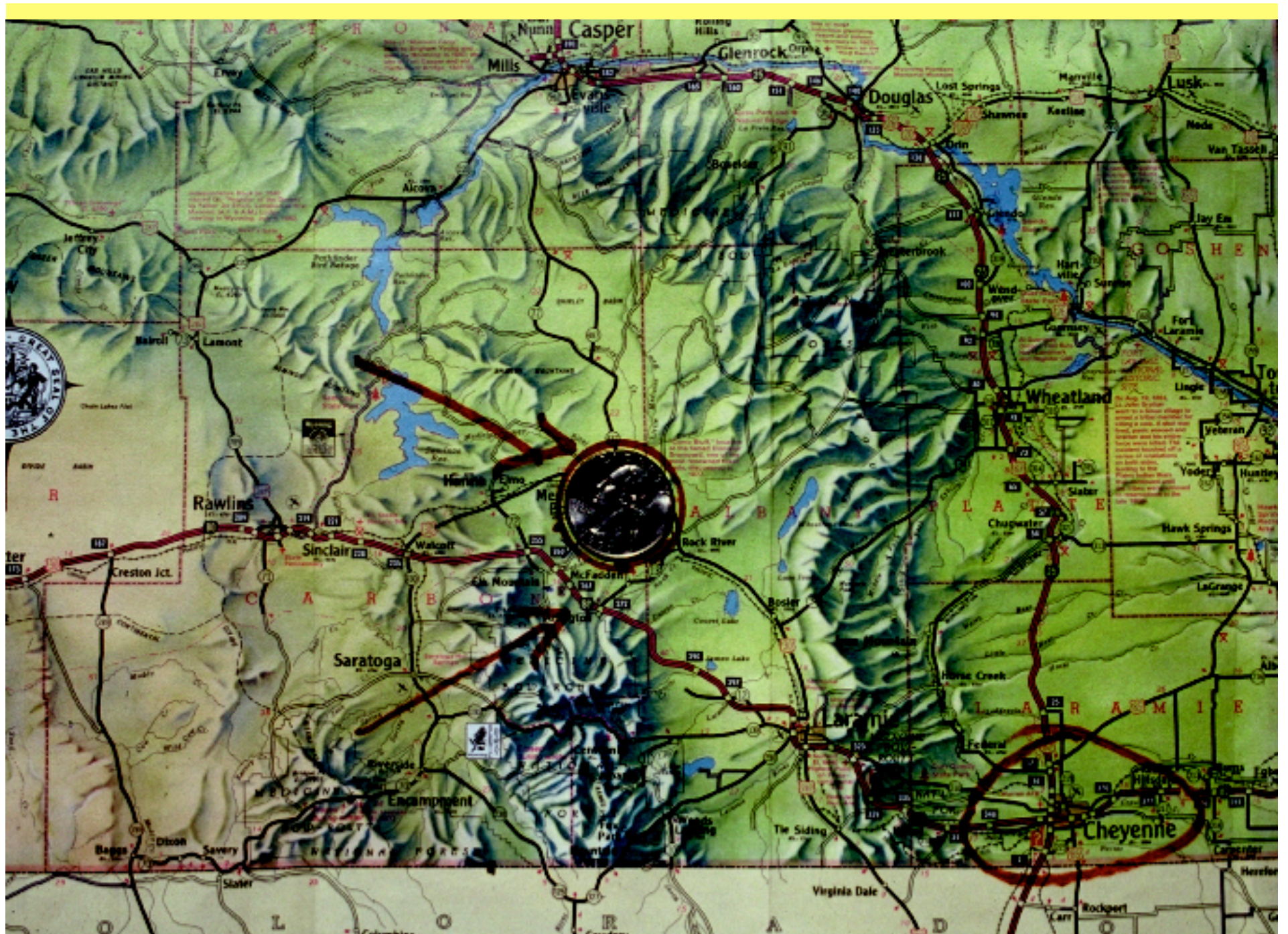
be refined on site to create any liquid fuel.

Timeline for CCS Experiment



Reality Check: 1 GT/YR = 25 M/B a day

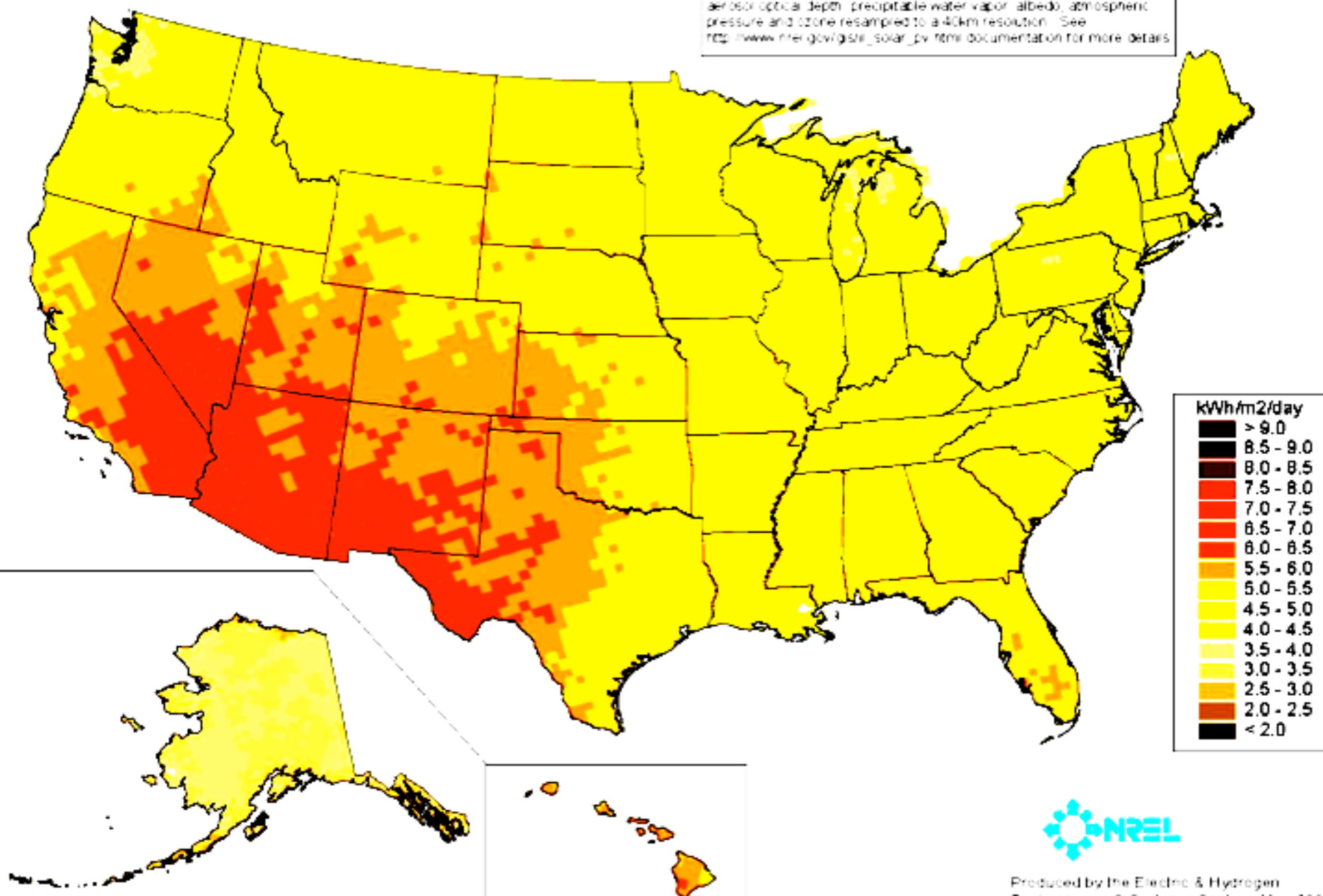




PV Solar Radiation (Flat Plate, Facing South, Latitude Tilt)

Annual

Model estimates of monthly average daily total radiation using inputs derived from satellite and/or surface observations of cloud cover, aerosol optical depth, precipitable water vapor, albedo, atmospheric pressure and ozone resampled to a 40km resolution. See http://www.nrel.gov/gis/solar_pv.html documentation for more details.





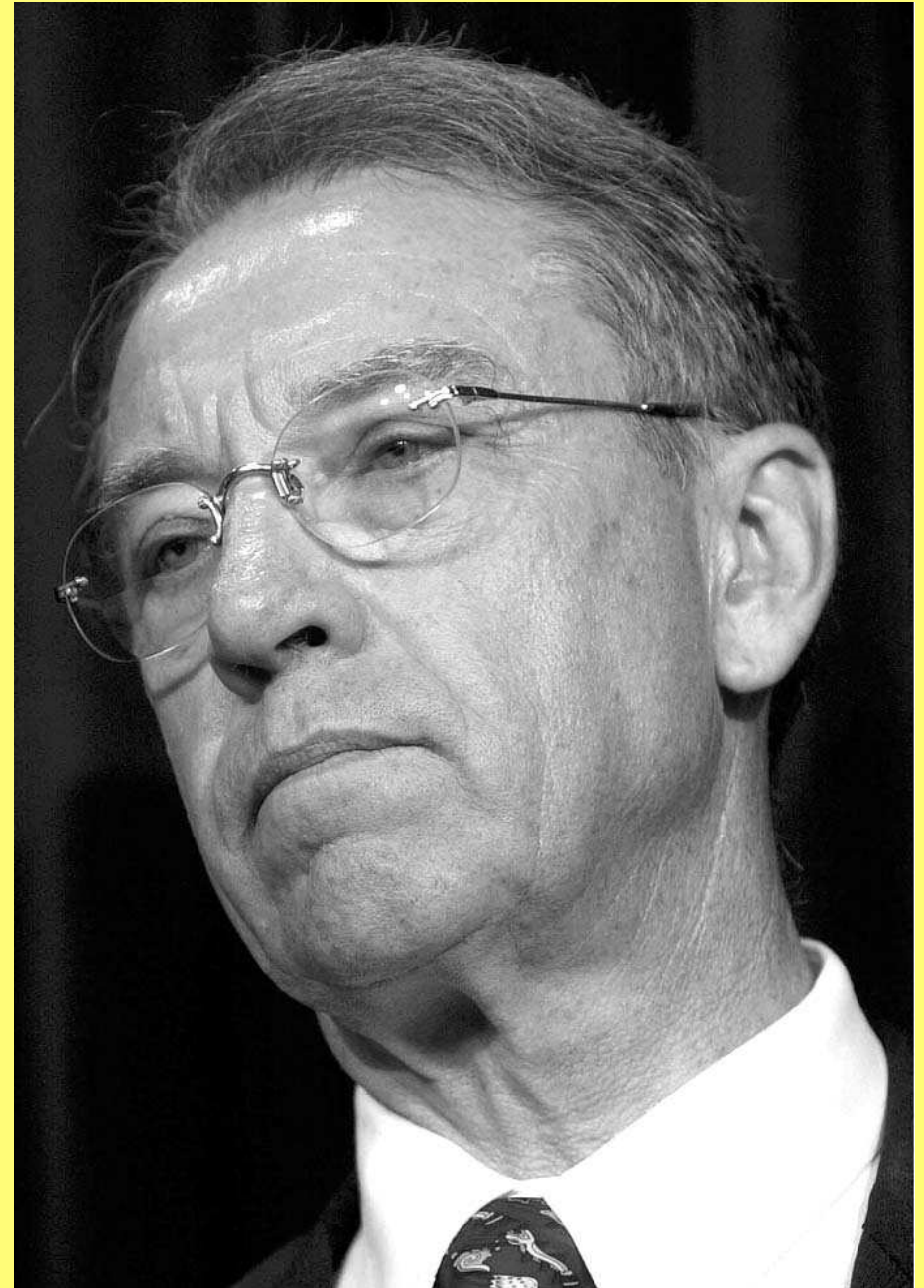
Americans and Energy

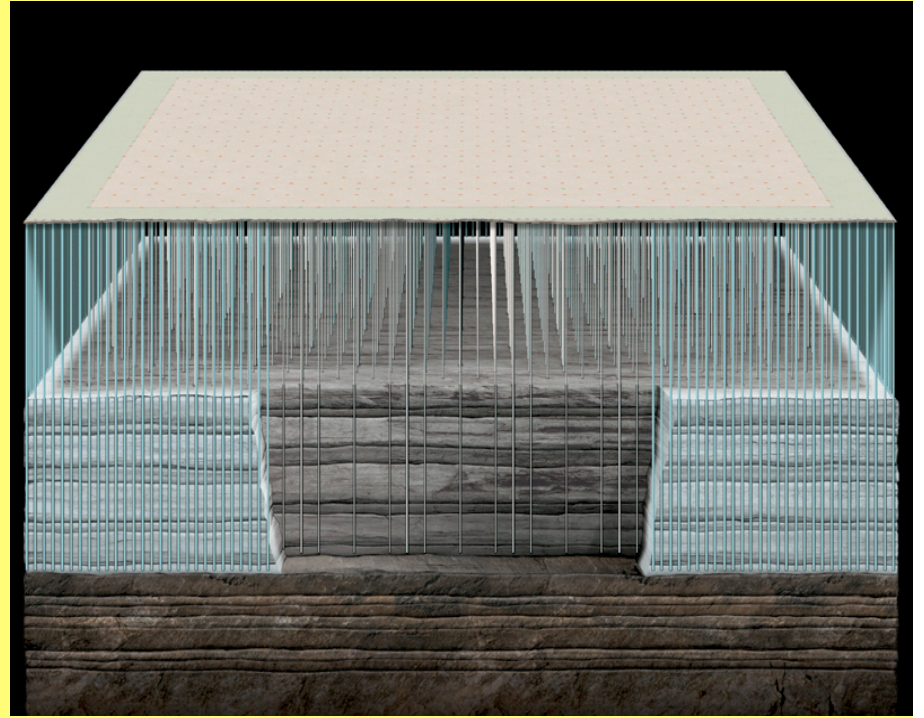
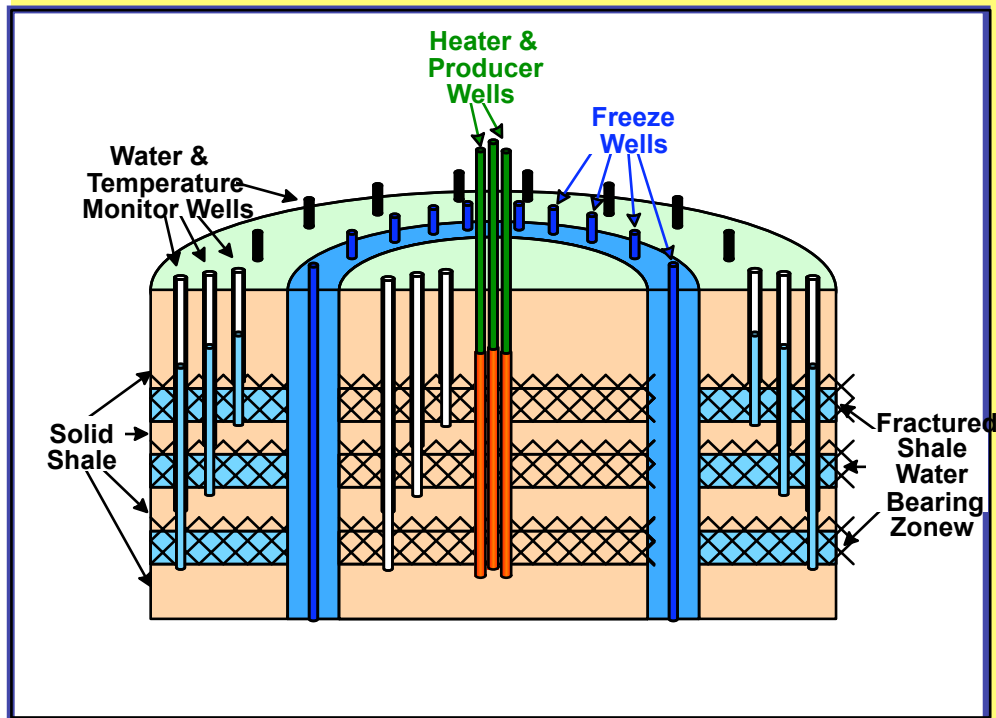


**News Flash:
“Power Outage
at Mall, 30
Stranded on
Escalator”**



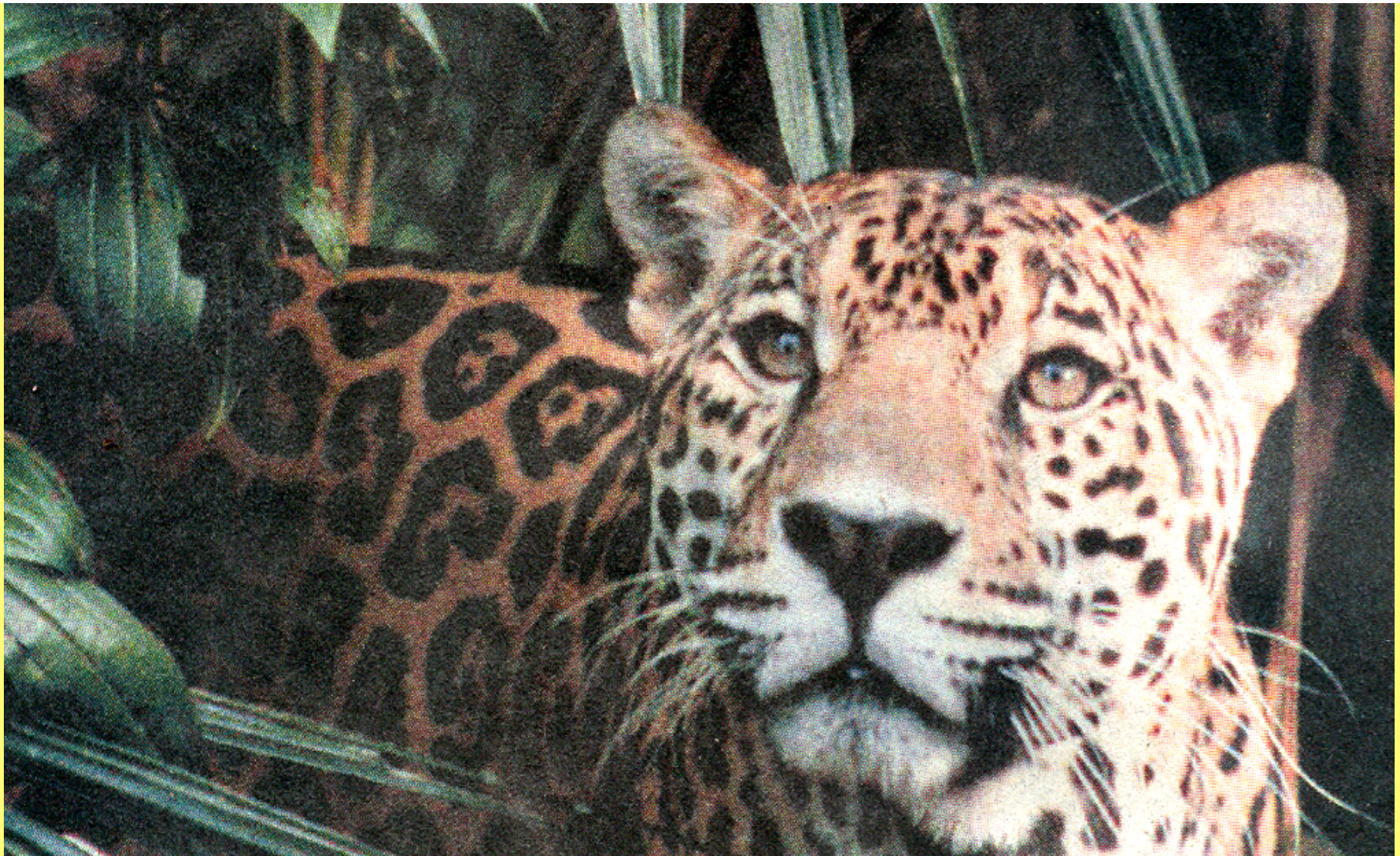
**Iowa Senator Charles
Grassley**





Oil Shale In Situ

- * Half world's oil shale in Colorado
- * 3x more energy in Cap'n Crunch than in oil shale
 - 100,000 b/d would require 1200 MW of new coal
 - 200 GT of carbon in Colorado oil shale



I am an ecologist, fascinated by energy. A predator cannot expend more energy in chasing prey than it gets from that prey...

Cost of Finding New Oil

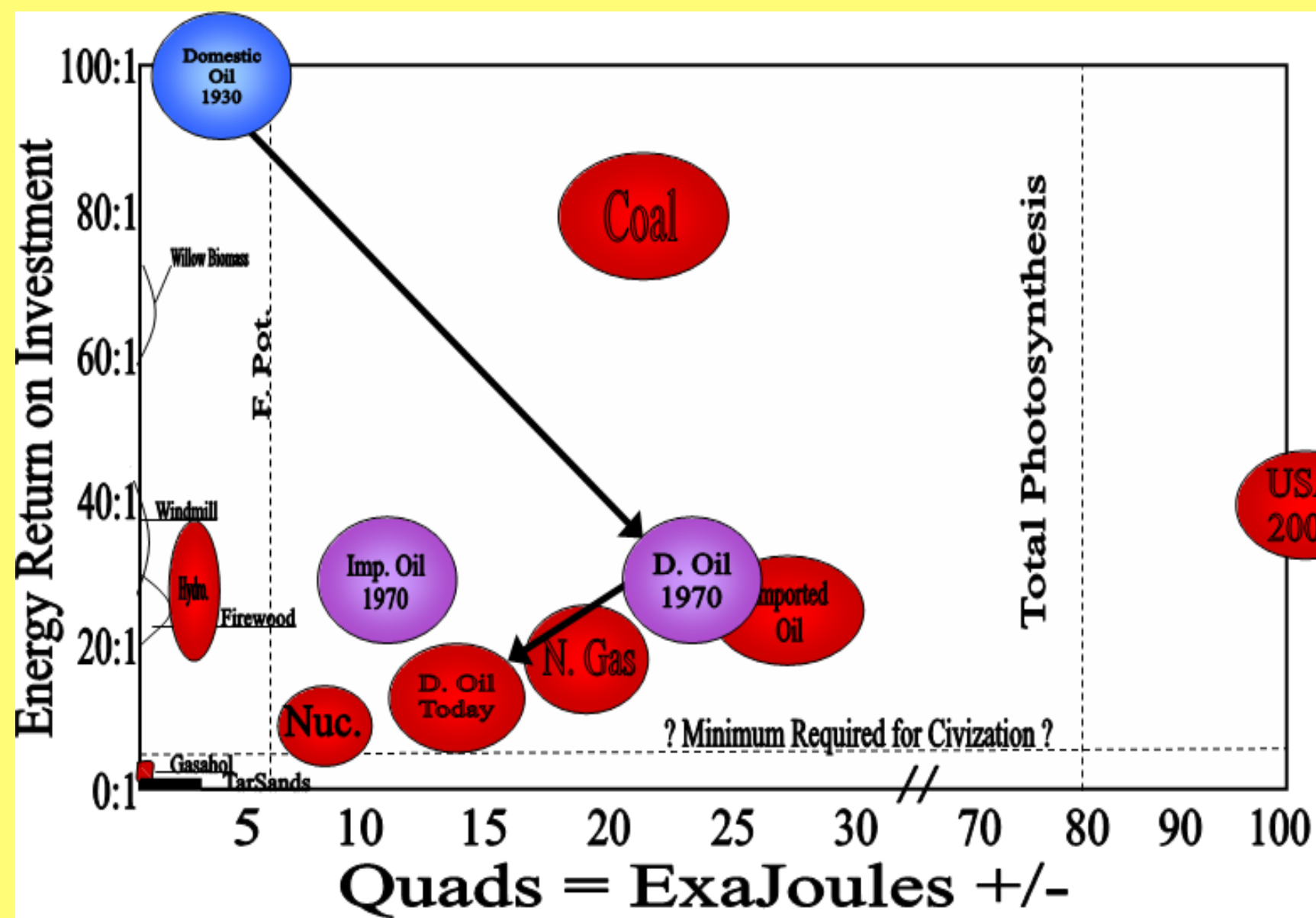
In 1930 U.S. got 100 barrels of oil back for each barrel invested in seeking it

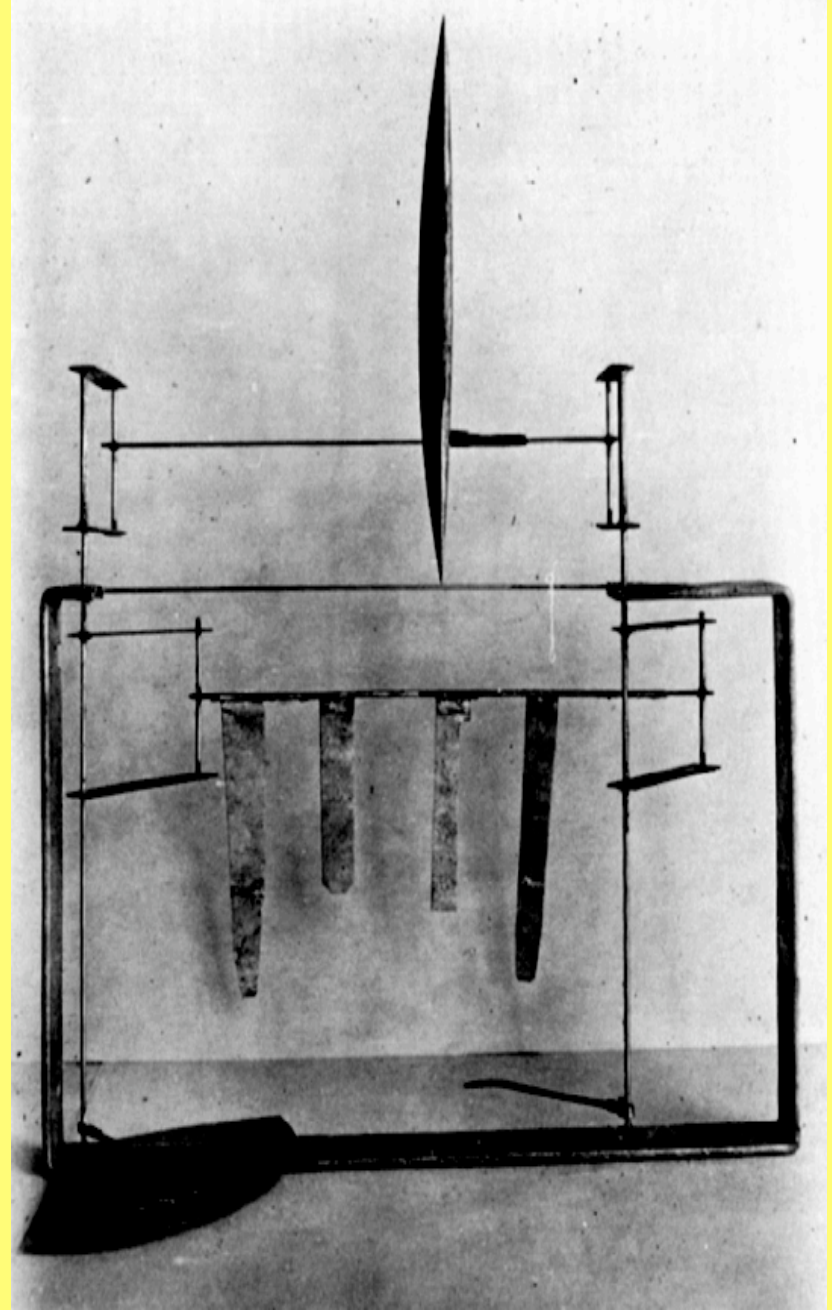
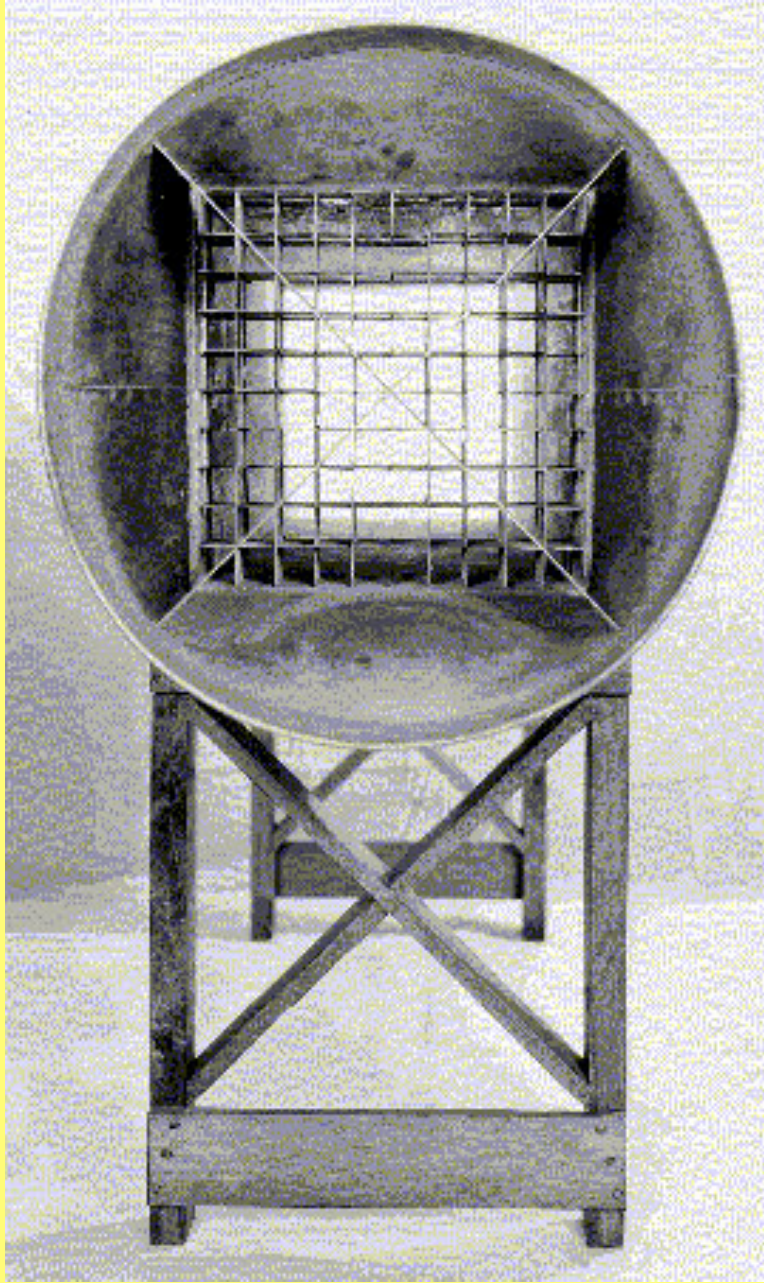
- In 1970 about 25:1
- In 1990s about 15:1
- Today... perhaps 5:1
- Tar Sands 4:1
- Coal Liquefaction 1:2

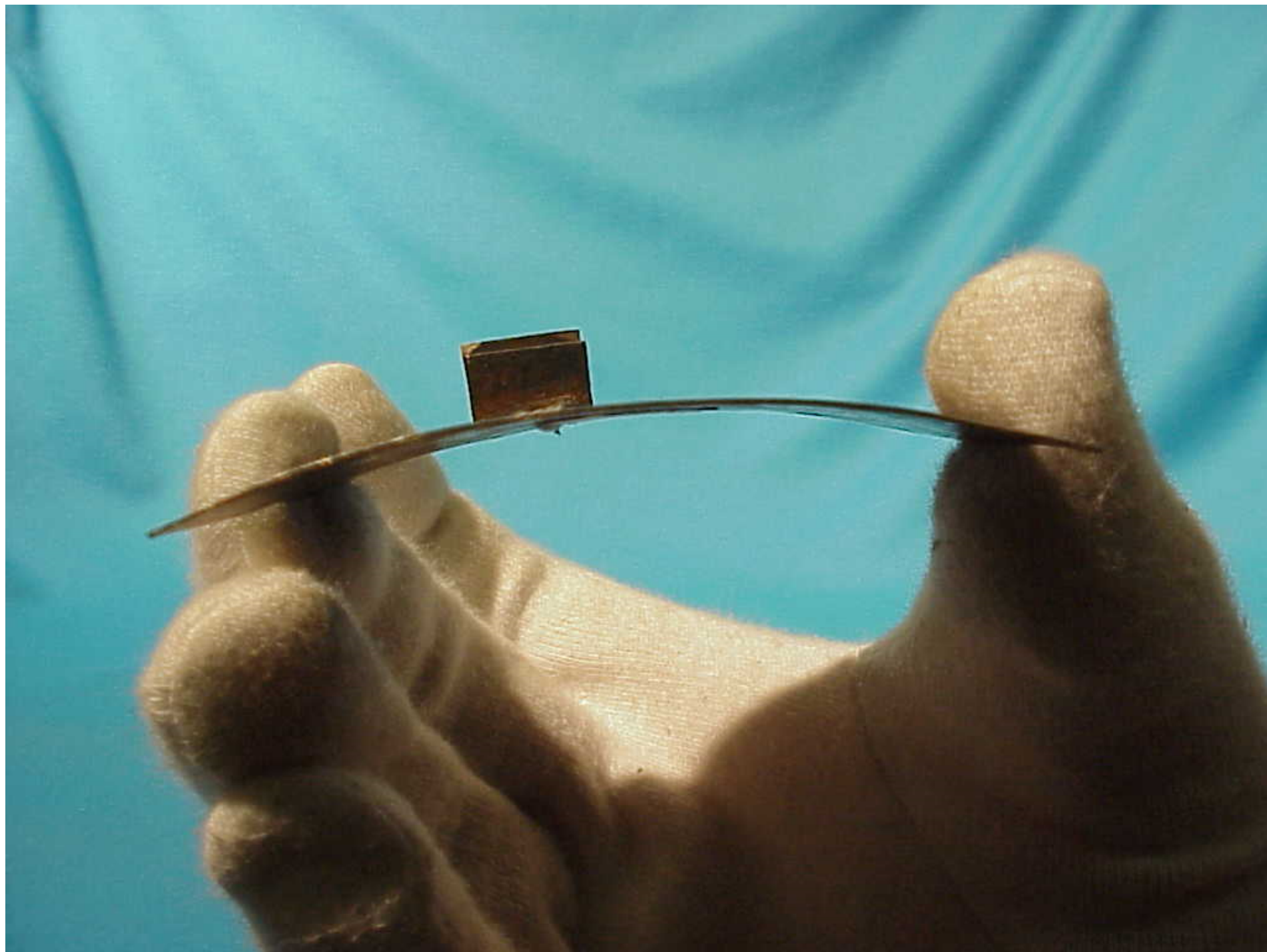


Wind? 40:1 PV? 5-8:1

Biofuels? 1:1 to 8:1

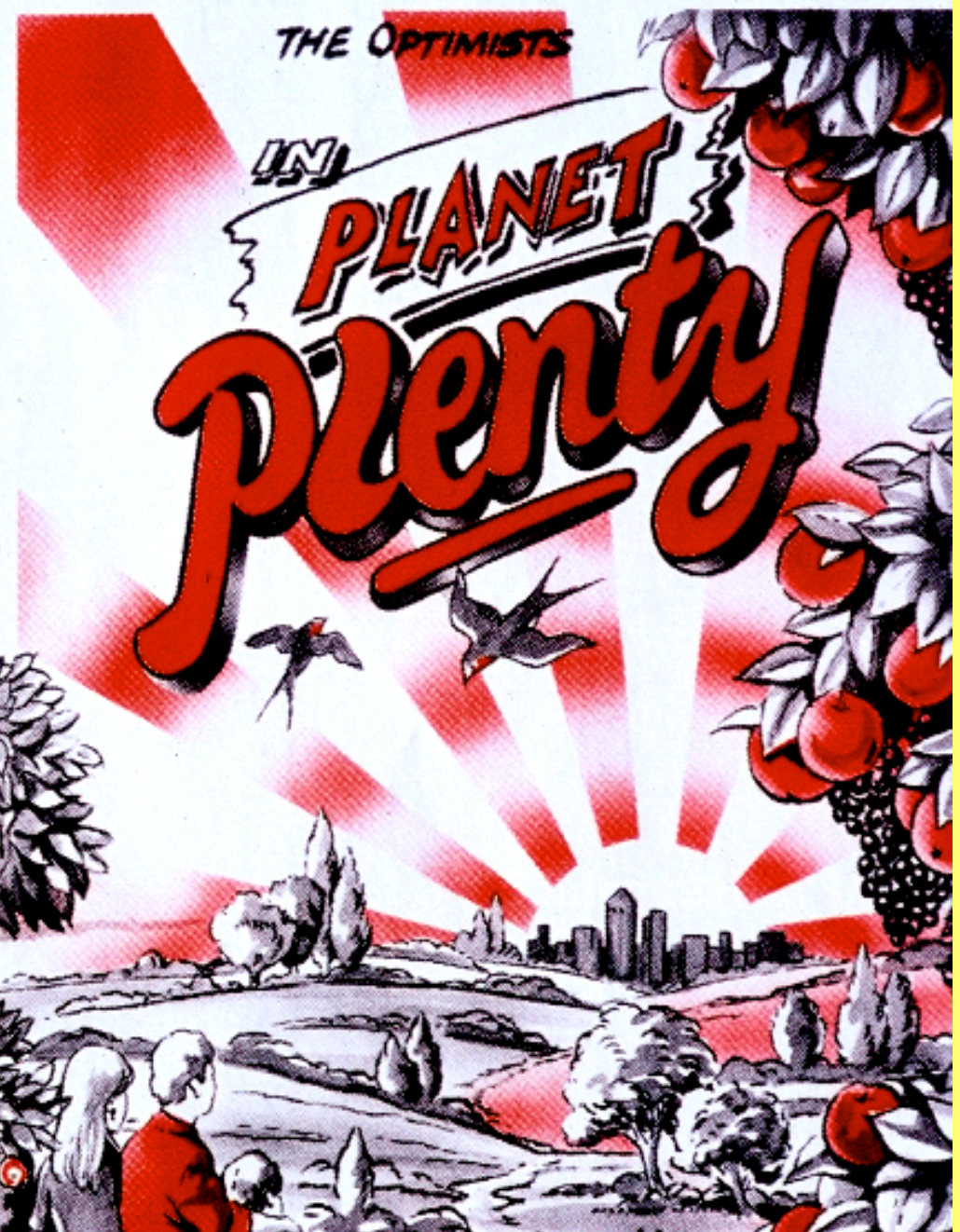






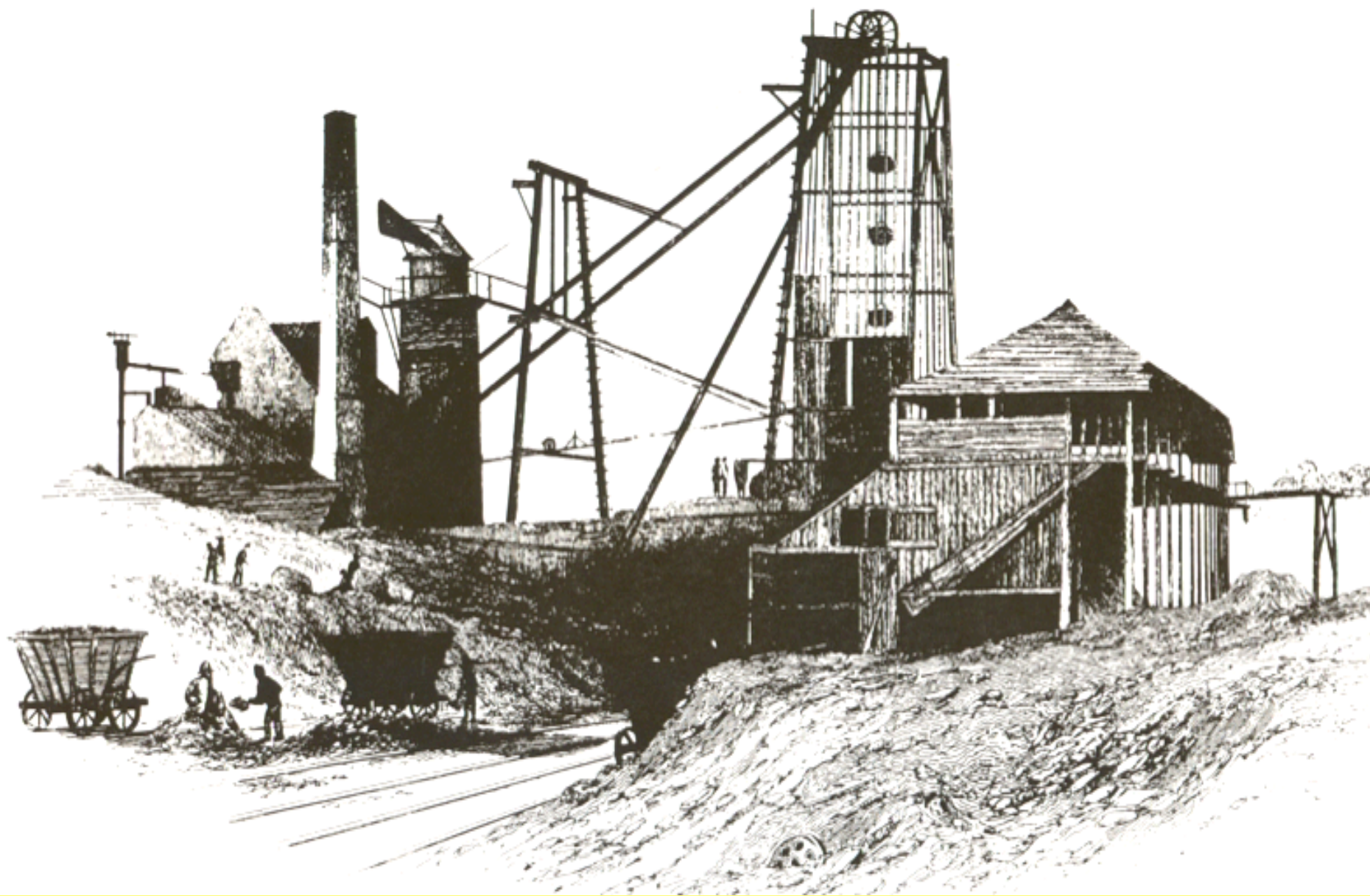
the scientist who first gave the warning is often embarrassingly to be found among the sceptics. Roger Revelle, nickname "Dr Greenhouse", who fired Al Gore with global warming evangelism, wrote just before his death in 1991: "The scientific basis for greenhouse warming is too uncertain to justify drastic action at this time."

Year 7 is the year of the quiet climbdown. Without fanfare, the official consensus estimate of the size of the problem is shrunk. Thus, when nobody was looking, the population "explosion" became an asymptotic rise to a maximum of just 15 billion; this was then





EFFICIENCY IS THE FUEL OF SUCCESS.



CHICKEN FEED & DOG FOOD

- GROCERIES = \$900
- MORTGAGE = \$1200
- CARS = \$400
- WATER/SEWER = \$40
- CABLE = \$30
- DOG FOOD = \$15
- BAD HAIRCUT = \$12
- CLEAN POWER = \$10

